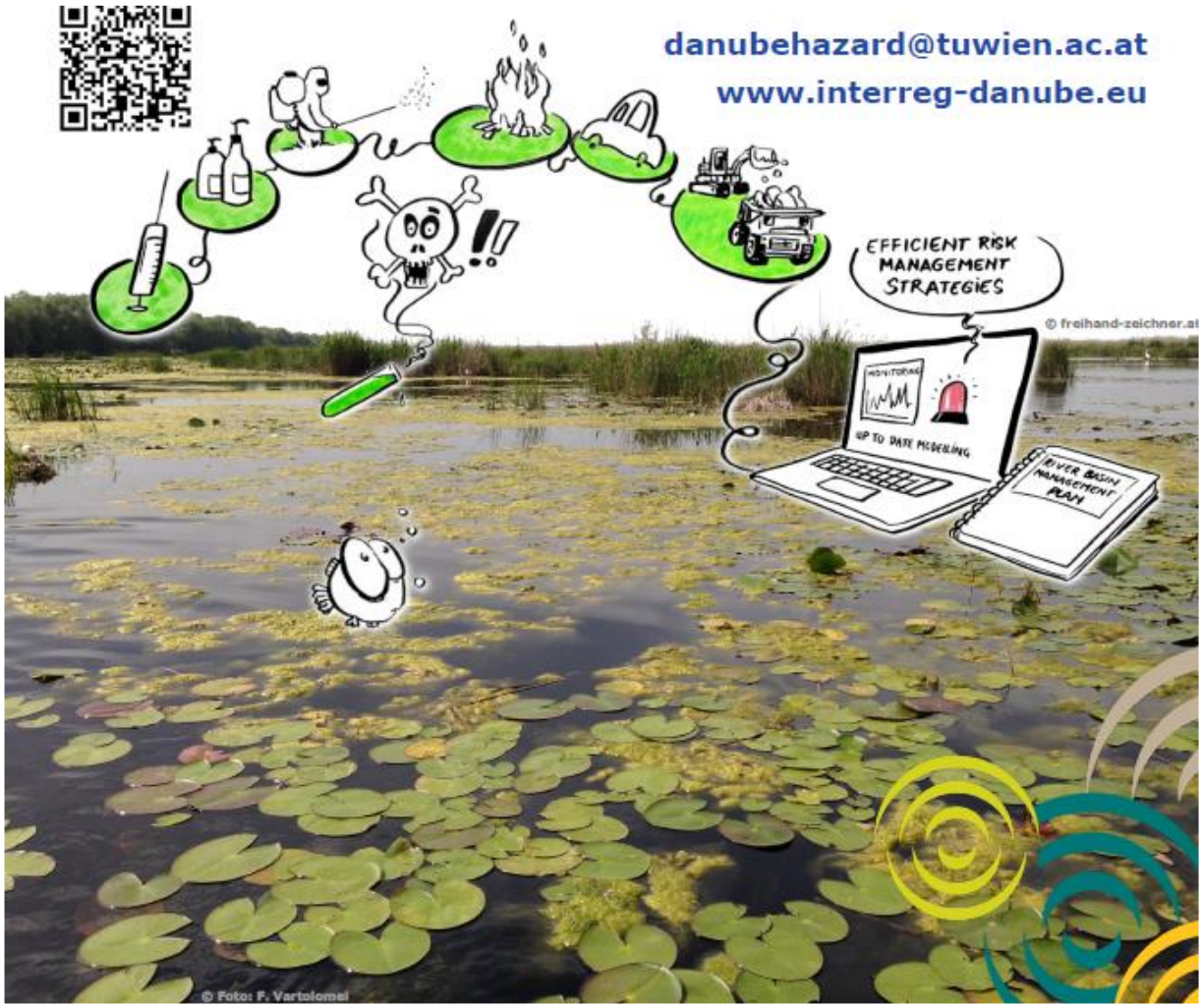

Output T2.3

Demonstration of the management plan development process at watershed levels for hazardous substances pollution based on detailed emission modelling in seven pilot regions 2023

Factsheet for the VIT Pilot area

Project co-funded by European Union funds (ERDF, IPA, ENI) and National Funds of the participating countries

PROJECT TITLE: Tackling hazardous substances pollution in the Danube River Basin by Measuring, Modelling-based Management and Capacity building

ACRONYM: Danube Hazard m³c

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Project co-funded by European Union funds (ERDF, IPA, ENI) and National Funds of the participating countries

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1. General introduction

Based on a one-year surface water monitoring, samples were taken once a week and combined to two-months composite samples and analyzed. Sampling took place mostly at low and mean flow conditions. The monitoring was established in all seven pilot regions in four countries (RO, BG, HU, AT) with a total of 20 surface water monitoring sites. From these results a mean annual concentration was calculated, which should be comparable to 12 fold monthly monitoring results, often used for the risk assessment under the Water Framework Directive. The risk assessment considers the following different inorganic and organic substances:

- Perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA) (industrial chemicals)
- 16 EPA Polycyclic aromatic hydrocarbons (PAHs, industrial chemicals, and combustion by-products)
- Mercury (Hg), Cadmium (Cd), Copper (Cu), Nickel (Ni), Lead (Pb), Zinc (Zn), Chromium (Cr) and Arsenic (As) (metals)
- Diclofenac and Carbamazepine (pharmaceuticals)
- 4-tert-Octylphenol (industrial chemical)
- Nonylphenol (industrial chemical)
- Bisphenol A (industrial chemical)
- S-Metolachlor (herbicide) including Metolachlor-ESA and Metolachlor-OA (metabolites)
- Tebuconazole (fungicide)

Results from all monitoring stations were compared with the environmental quality standards (EQS) of Directive2008/105/EU (Priority Substances) and with the substances enacted at the national level (National Substance List). Exceedances are shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Table 1 Overview of the exceedance of the EQS in all pilot areas. The numbers indicate the number of sites, regions and countries with exceedance of the EQS values

Substance > EQS	Substance Group	No of monitoring sites	No of pilot regions	No of countries	Regulation
PFOS	Industry	9	5	4	Directive 2008/105/EU
Cu	Heavy Metals	2	1	1	National Substance List
Cd	Heavy Metals	2	1	1	Directive 2008/105/EU
Zn	Heavy Metals	2	1	1	National Substance List
s-Metolachlor	Pesticides	2	1	1	National Substance List

In a second step, for each substance, dominant pathways were evaluated for each catchment by means of emission modelling. Considering the dominant polluters or pathways, scenarios were formulated, which, describe the general potential of a specific measure to mitigate pollution.

The emission modelling was carried out for 34 sub-catchments in seven pilot areas which are situated in four countries. A detailed description of the model, the modelling results and validation can be found in OT 2.2 Report on improved system understanding.

Note: The new proposals of the revised Priority Substance List were also assessed, but do not form a legal basis for the designation of measures at the present time.

2. General information VIT Catchment

The Vit pilot region under investigation devides into five sub-catchments. Monitoring was carried out at the outlets of the two upstream catchments (41005 and 41004) and at the outlet of the pilot

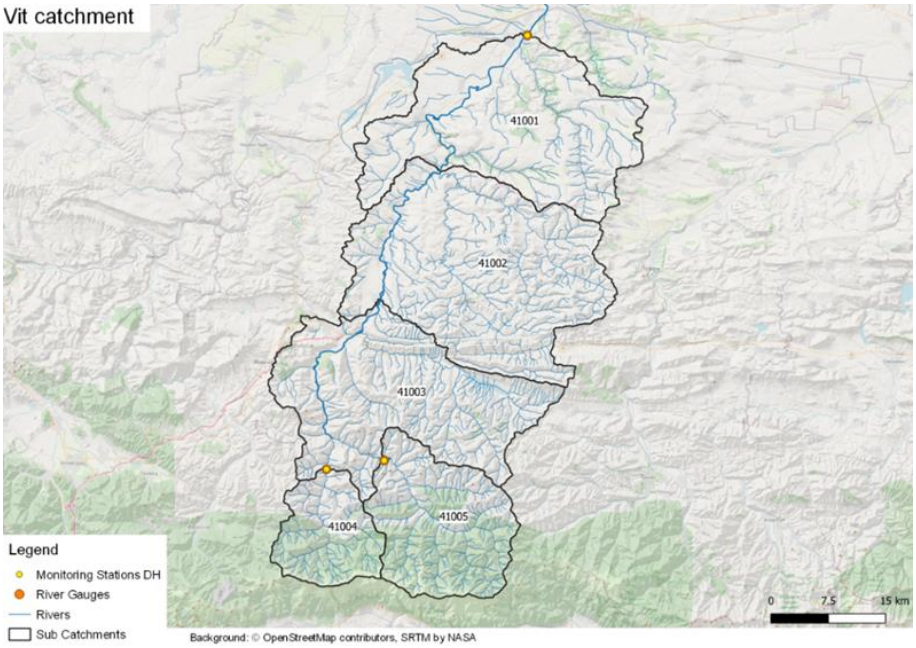

Figure 1 Overview of the pilot area, with monitoring stations

region.

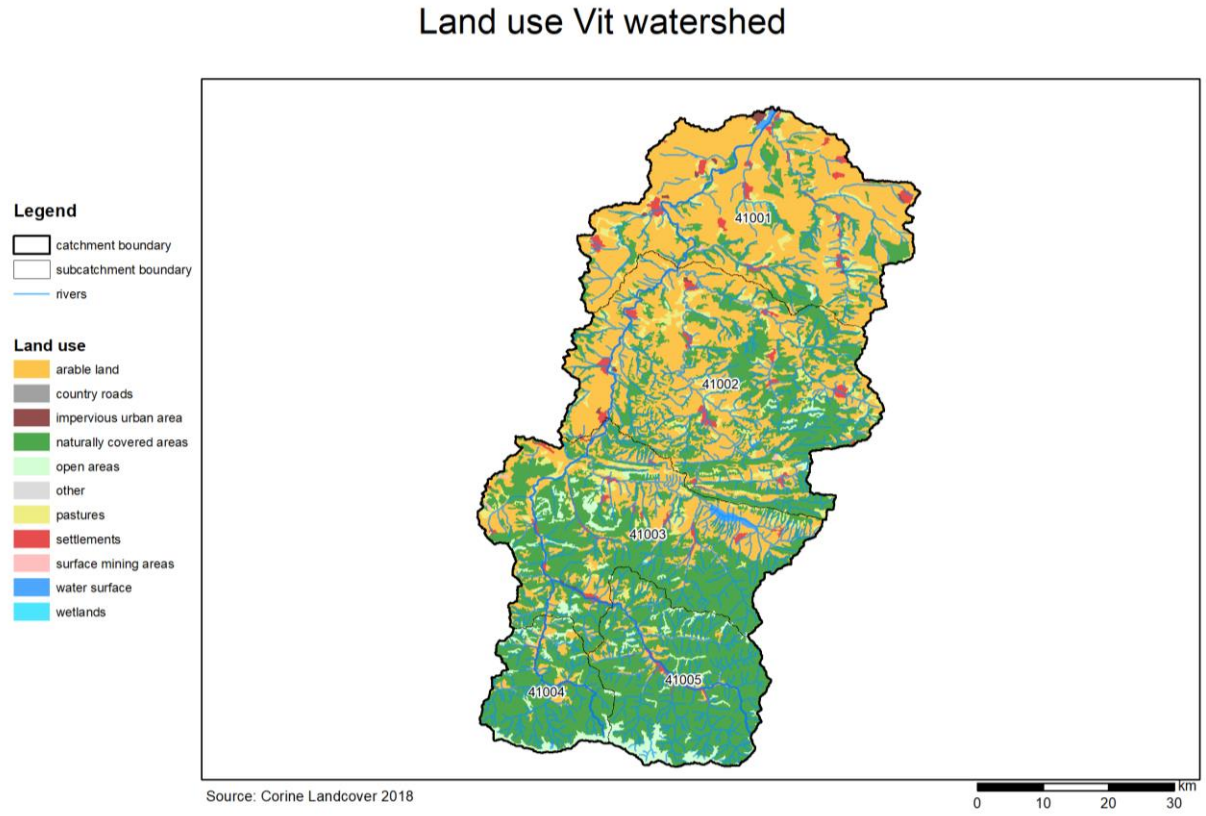

Figure 2 Land use in the pilot area

The dominant landuse in the upper, mountainous region of the pilot region is forestry. In the downstream parts, the influence of agriculture increases, with a clear focus on arable land. About 30 % of the arable land is situated on fields with a slope of more than 4 %. The area has the lowest population density of all pilot regions and the runoff is moderate.

Table 2 Basic information for the Vit pilot area

Pilot region	**Catchment Area [km2]**	**Mean Elevation [m]**	**Population density [Inh/km2]**	**Arable land [%]**	**Arable land > 4% slope [%]**	**Pasture [%]**	**Forest [%]**	**Urban Area [%]**	**Runoff [mm]**
Vit	2206,3	519,8	7	42,8	28,9	5,4	45,4	2,3	197

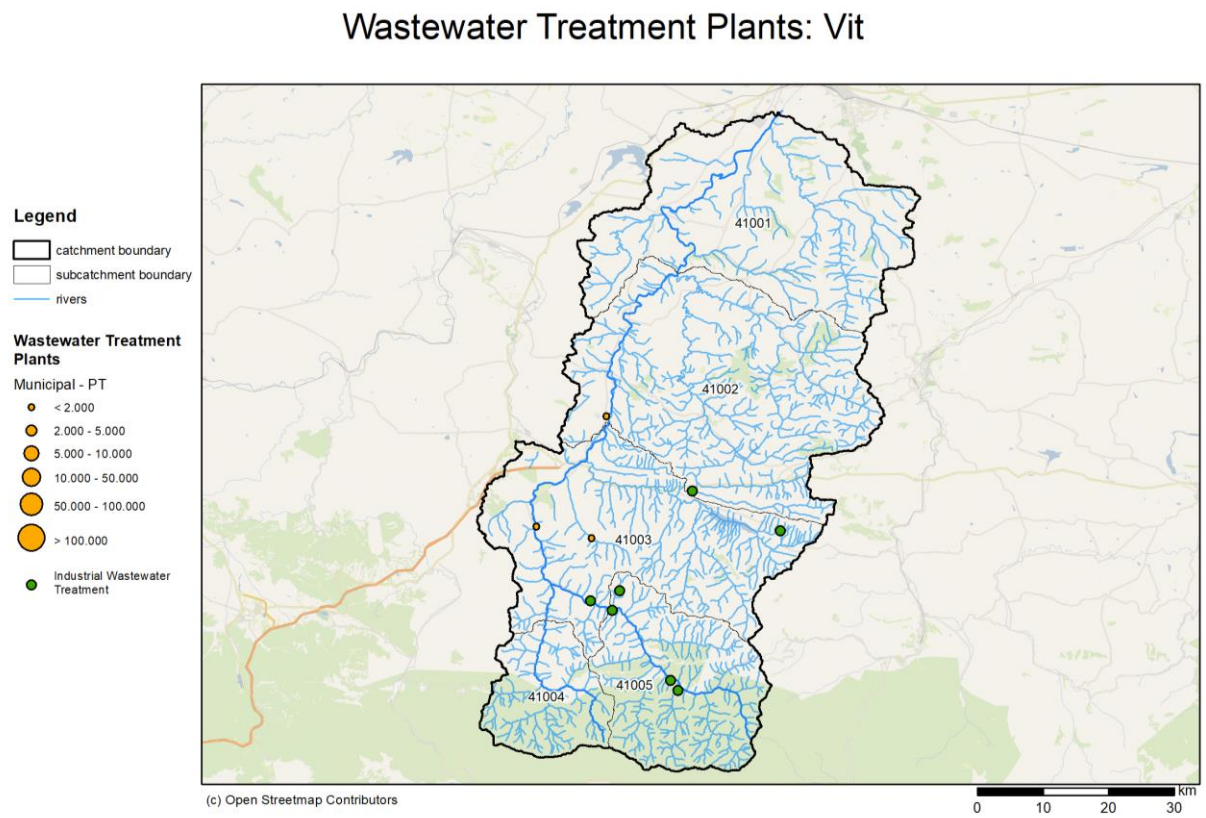

Figure 3 Overview of the point sources in the pilot area

In the VIT catchment, there are three small municipal WWTPs and several small industrial WWTPs

3. Risk assessment: Industry and wastewater/Perfluorooctane sulfonic acid (PFOS)

The monitoring results from three sub-catchments (41005, 41004 and 41001) point out that in the Vit catchment only PFOS EQS (0,00065 µg/l) is exceeded at the outlet of the study area (41001) by a factor of 1,1. Measurements of the other monitored stations (headwaters) show concentrations below the limit of detection (0,00015 µg/l). Model results from sub-catchments not monitored show similar low concentration values.

General information: Perfluorooctane sulfonic acid (PFOS) (CAS number 1763-23-1) belongs to the substance group of per- and polyfluorinated alkyl compounds. Due to the surface-active properties of PFOS and related compounds, they are also referred to as perfluorinated surfactants (PFTs). PFOS were formerly used in a wide variety of applications such as fire extinguishing foams, photo resist paints, photographic coatings, medical devices, insecticides, textiles and carpets, and paper and packaging. Due to persistence and surface-active properties, PFOS are very difficult to remove. The main pathways of PFOS to enter surface waters are wastewater effluents (industrial and municipal wastewater), surface runoff and groundwater.

3.1 Specific situation for Vit

In the Vit catchment, the dominant pathways for PFOS emission are groundwater and surface runoff. Direct emission from untreated wastewater via sewer systems discharging into surface water is another significant pathway. Treatment of untreated wastewater is a measure with a valuable effect, not only with respect to decrease PFOS concentrations. Due to the only slight exceedance of the EQS of factor 1,1 the treatment of wastewater in the pilot region can be a sufficient measure to undershoot the PFOS EQS in sub-catchment 41001.

Figure 4 makes it clear that the area specific emissions are not very high, which is also reflected in only a slight exceedance of the EQS.

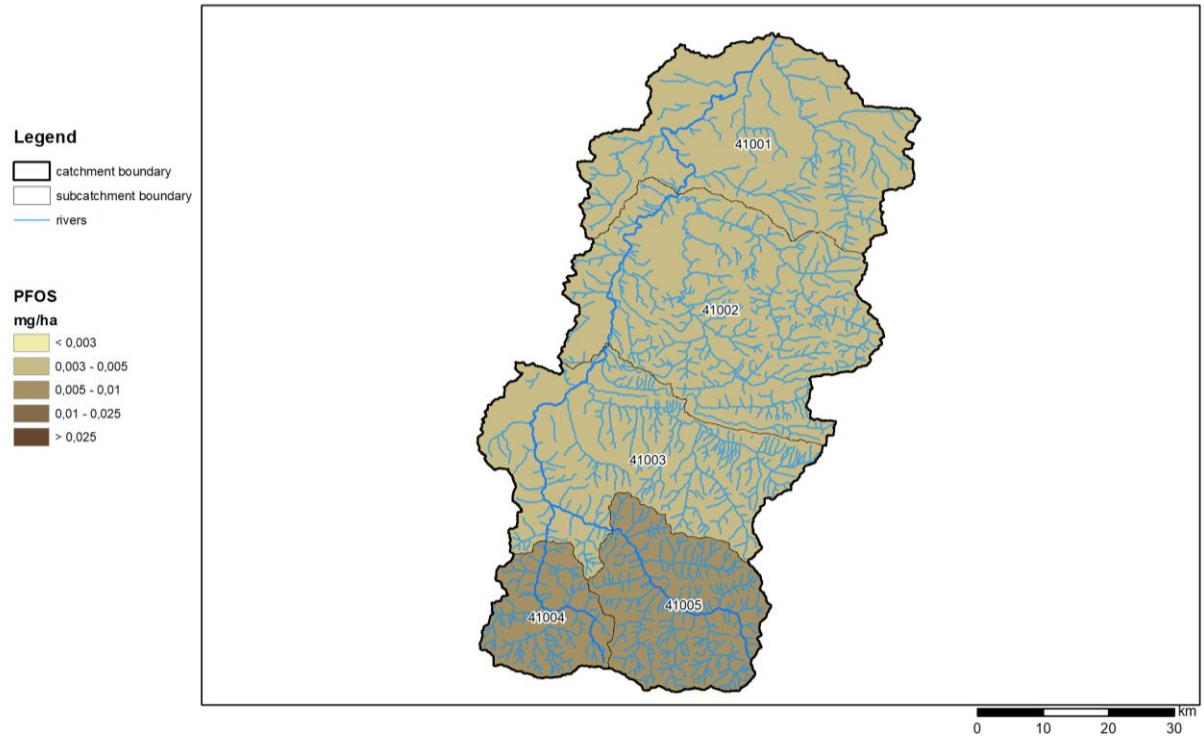

Figure 4 Area specific total PFOS emissions in the Vit catchment.

When looking at the relative share of pathways in figure 5, it can be seen that almost all PFOS emissions come from diffuse pathways (e.g. groundwater and surface runoff) . In 41002, 41003 & 41005 also sewer systems contribute significantly to the total emissions.

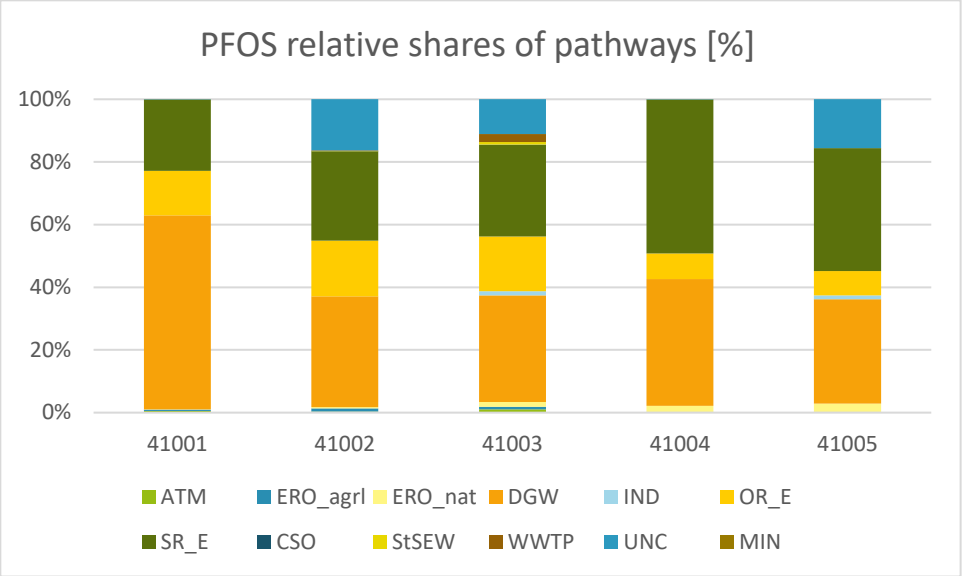

Figure 5 Relative share of pathways for PFOS in all Vit subcatchments. (ATM: atmospheric deposition; ERO_agrl: erosion from agricultural land; ERO_nat: erosion from forests; DGW: groundwater baseflow+interflow+drainages; IND: industrial point sources; OR_E: extra-urban roads; SR_E: surface runoff; CSO: combined stormwater overflow; StSEW: strom sewer; WWTP: municipal WWTP; UNC: sewer systems not connected to WWTP; MIN: abandoned mining)

3.2 Proposals for potential mitigation measures

Currently, a lot of research for removing PFOS from water is done worldwide. However, repair of the sewerage system, construction of well-operated small wastewater treatment plants and optimization of existing wastewater treatment plants can have a positive impact to reduce PFOS concentrations in surface waters.

Please note: The proposed measures are based exclusively on what is theoretically feasible and quantifiable as a scenario in the model. They do not consider the aspect of proportionality and have no impact on a possible practical implementation!

3.3 Results from the modeled scenarios

As there are no WWTPs with a capacity above 10.000 PE situated in the Vit catchment, no scenarios where modeled for the Vit catchment.

3.4 Initiate a stakeholder involvement

A questionnaire was set up to ask for the feasibility of mitigation measures for the reduction of PFOS concentrations in the VIT catchment. 8 local, regional and national experts responded the questionnaire. 5 out of 8 persons responded that no restoration or extension of the sewerage system would be planned. Three persons did not respond to this question. 7 experts believe that restoring or building new small WWTP is technically feasible. However, only 3 experts think that this

is financially feasible as well. Only one person believes, that a reduction of PFOS is possible through other measures being related to source control.

4. Closing the data gaps

For this project, erosion data for Bulgaria from the JRC were used, which especially in the VIT catchment show very high erosion rates. Therefore, it is advised that a countrywide erosion model should be developed.

For the Vit Catchment, very few information on the sewer systems and the connected households was available. All information used in the current model application for the urban systems in the Vit pilot area is based on expert judgement, because official information was not available.